



# King Saud University

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### EDITORIAL

## Directions in mechanical engineering

Mechanical engineering, a field that dates back to the Industrial Revolution, has traditionally been thought in terms of engines and machinery, and, consequently as a key discipline for the analysis, design, and manufacturing of transportation systems, energy production systems, and industrial equipment. Hence, physics is at its core with mechanics, kinematics, materials science, transport phenomena, control systems, manufacturing, and thermodynamics being the practical disciplines in which mechanical engineers are trained. And design, the creation of “what is next,” permeates almost everything that mechanical engineers touch.

Yet today, we see divergence in mechanical engineering. On one hand, there is an emphasis on energy and sustainability, which involves traditional mechanical systems for power generation, heating and cooling, transportation, and energy production. These systems depend on the core of mechanical engineering: thermodynamics, mechanics, combustion, and transport phenomena. Likewise, global competition demands improvements in robotics, manufacturing, and transportation, all depending on traditional core principles related to control systems, mechanism design, vibration, and mechanics. On the other hand, newer fields that mechanical engineers touch include nanotechnology, biotechnology, electronics, and biomechanics. Some of these are natural extensions of concepts traditionally taught to mechanical engineering students, while others demand connections with chemistry, biology, medicine, and solid state devices that most mechanical engineers do not know well.

The question is if mechanical engineering as a discipline should stick to its roots or aggressively expand into these new fields. Where this becomes quite evident is in advertisements for mechanical engineering faculty positions. Several years ago, advertisements focused on manufacturing; more recently on micromechanical devices and nanotechnology; now on energy systems. The problem, of course, is that engineering schools tend to hire faculty in very specific “hot” sub-areas of mechanical engineering. This can lead to problems down the line (after tenure) in adapting to new

directions in funding as well as in teaching core courses within the discipline.

Perhaps the underlying cause of problems is the nature of research funding in developed countries like the US, Europe, and Japan. In regions with strong, developed economies there is a long-standing tradition of research funding emphasizing expanding into new fields of research. But this often is at the expense of more traditional fields leading to a mismatch between faculty research interests and the fundamentals that mechanical engineering students need to learn.

The mismatch is perhaps more problematic in countries with developing economies. To be visible internationally, researchers need to perform successful research in “hot” engineering topics, but the needs in a developing country are different and tend to be more fundamental. Hence, research funding in developing economies, in addition to being smaller in scale, favors traditional engineering subjects. This not only makes international recognition difficult for faculty, but it also can adversely affect graduate students from developing countries. Either they train locally in traditional mechanical engineering topics that get little international credit, or they train internationally in non-traditional topics that do not translate well to the research needs of their home country.

What is the solution? The key is to embrace the breadth of mechanical engineering. The fundamentals of mechanical engineering are broadly applicable. It is solid training in fundamentals, yet connected to current research problems, both traditional and peripheral to the discipline, that will strengthen and maintain mechanical engineering as a leading engineering discipline.

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